

## Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in this application.

### Listing of Claims:

Claim 1 (Previously Presented): A method for manufacturing an object having a potential  $\{x\}$  that is generated in response to a field  $\{f\}$  applied thereto, the method comprising:

generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements and specifying values for the field  $\{f\}$  and potential  $\{x\}$  relative to the finite elements;

specifying that the material properties of the finite elements have a particular symmetry;

calculating a material property matrix  $[k]$  based on the relationship  $\{f\}=[k]\{x\}$  and the specified symmetry;

extracting material property coefficients from the material property matrix  $[k]$  for each finite element in the computerized mathematical model;

comparing the extracted material property coefficients to material property coefficients for known materials to match the extracted material property coefficients to the material property coefficients for known materials;

determining manufacturing parameters for controlling manufacturing equipment for each volume increment of the object based on the matched material property coefficients;

controlling the manufacturing equipment in accordance with the determined manufacturing parameters to thereby manufacture the object; and

introducing an impurity into the object while the object is manufactured, wherein an amount of the introduced impurity is variable for the respective volume increments of the object.

Claim 2 (Original): The method according to claim 1, wherein the material properties of the finite elements are specified to be isotropic.

Claim 3 (Original): The method according to claim 1, wherein the material properties of the finite elements are specified to be transversely isotropic.

Claim 4 (Previously Presented): The method according to claim 1, wherein the generating of a computerized mathematical model of the object further includes determining the smallest volume increment that can be manufactured using the manufacturing equipment.

Claim 5 (Original): The method according to claim 1, wherein the field  $\{f\}$  is a mechanical force field and the potential  $\{x\}$  is a displacement.

Claim 6 (Original): The method according to claim 1, wherein the field  $\{f\}$  is an electric current field and the potential  $\{x\}$  is a voltage.

Claim 7 (Original): The method according to claim 1, wherein the field {f} is a magnetic field and the potential {x} is a magnetic vector potential.

Claim 8 (Original): The method according to claim 1, wherein the field {f} is a thermal flux field and the potential {x} is a temperature.

Claim 9 (Original): The method according to claim 1, wherein the field {f} is a fluid velocity field and the potential {x} is a fluid potential.

Claim 10 (Previously Presented): The method according to claim 1, wherein the controlling of the manufacturing equipment comprises controlling a composite manufacturing equipment for manufacturing a composite material.

Claim 11 (Previously Presented): The method according to claim 10, wherein the composite material comprises structural fibers laminated in a matrix and the impurity is introduced into the matrix.

Claim 12 (Previously Presented): The method according to claim 11, wherein the impurity comprises biologic material.

Claim 13 (Previously Presented): The method according to claim 11, wherein the impurity comprises bone.

Claim 14 (Previously Presented): The method according to claim 11, wherein the impurity comprises crushed bone.

Claim 15 (Previously Presented): The method according to claim 11, wherein the impurity comprises co-factors.

Claim 16 (Previously Presented): The method according to claim 11, wherein the impurity comprises biological cells.

Claim 17 (Previously Presented): The method according to claim 11, wherein the impurity comprises bio-active materials.

Claim 18 (Previously Presented): The method according to claim 11, wherein the impurity comprises medications.

Claim 19 (Previously Presented): The method according to claim 11, wherein the impurity comprises antibiotics.

Claim 20 (Previously Presented): The method according to claim 11, wherein the impurity comprises radioactive materials.

Claim 21 (Currently Amended): The method according to claim 1, wherein the object being manufactured is a prosthetic implant for replacing a body part and the

field force {f} and potential displacement {x} are specified based on the in vivo forces applied to the body part to be replaced and the in vivo displacements generated in the body part to be replaced when the forces are applied thereto.

Claim 22 (Previously Presented): An object made in accordance with the method of claim 1, wherein the object is selected from the group consisting of an automobile part, an aircraft part, a prosthetic implant, a golf club shaft, a tennis racket, a bicycle frame, and a fishing pole, and wherein different portions of the object have different material properties corresponding to the matched extracted material property coefficients for known materials.

Claim 23 (Original): A prosthetic implant manufactured in accordance with the method of claim 1.

Claim 24 (Original): A golf club manufactured in accordance with the method of claim 1.

Claim 25 (Previously Presented): A computer-implemented method for determining machine control instructions for manufacturing an object having a potential {x} that is generated in response to a field {f} applied thereto, the method comprising:

generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements and specifying values of the field {f} and potential {x} relative to the finite elements;

specifying that the material properties of the finite elements have a particular symmetry;

calculating a material property matrix  $[k]$  based on the relationship  $\{f\}=[k]\{x\}$  and the specified symmetry;

extracting material property coefficients from the material property matrix  $[k]$  for each finite element in the computerized mathematical model;

comparing the extracted material property coefficients to material property coefficients for known materials to match the extracted material property coefficients to the material property coefficients for known materials;

determining manufacturing parameters for controlling manufacturing equipment for each volume increment of the object based on the matched material property coefficients;

generating machine control instructions for controlling the manufacturing equipment in accordance with the manufacturing parameters to manufacture the object; and

generating further machine control instructions for controlling the manufacturing equipment to introduce an impurity into the object while the object is manufactured, wherein an amount of the introduced impurity is variable for the respective volume increments of the object.

Claim 26 (Currently Amended): The method according to claim 25, wherein the object being manufactured is a prosthetic implant for replacing a body part and the field force  $\{f\}$  and potential displacement  $\{x\}$  are specified based on the in vivo forces

applied to the body part to be replaced and the in vivo displacements generated in the body part to be replaced when the forces are applied thereto.

Claim 27 (Previously Presented): The method according to claim 25, wherein the generating of machine control instructions comprises generating machine control instructions for controlling composite manufacturing equipment for manufacturing a composite material.

Claim 28 (Previously Presented): The method according to claim 27, wherein the composite material comprises structural fibers laminated in a matrix and the impurity is introduced into the matrix.

Claim 29 (Previously Presented): The method according to claim 28, wherein the impurity comprises biologic material.

Claim 30 (Previously Presented): The method according to claim 28, wherein the impurity comprises bone.

Claim 31 (Previously Presented): The method according to claim 28, wherein the impurity comprises crushed bone.

Claim 32 (Previously Presented): The method according to claim 28, wherein the impurity comprises co-factors.

Claim 33 (Previously Presented): The method according to claim 28, wherein the impurity comprises biological cells.

Claim 34 (Previously Presented): The method according to claim 28, wherein the impurity comprises bio-active materials.

Claim 35 (Previously Presented): The method according to claim 28, wherein the impurity comprises medications.

Claim 36 (Previously Presented): The method according to claim 28, wherein the impurity comprises antibiotics.

Claim 37 (Previously Presented): The method according to claim 28, wherein the impurity comprises radioactive materials.

Claim 38 (Original): A computer system programmed to perform the method of claim 25.

Claim 39 (Original): A control system programmed with machine control instructions for controlling composite manufacturing equipment to manufacture a composite object, wherein the machine control instructions are generated in accordance with the method of claim 25.



Claim 40 (Original): Composite manufacturing equipment comprising a control system programmed with machine control instructions for controlling the composite manufacturing equipment to manufacture a composite object, wherein the machine control instructions are generated in accordance with the method of claim 25.

Claim 41 (Previously Presented): A method for manufacturing an object for which a defined field  $\{f\}$  generates a potential  $\{x\}$  in response thereto, the method comprising:

- (1) generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements;
- (2) specifying values of the field  $\{f\}$  and the potential  $\{x\}$  relative to the finite elements;
- (3) specifying that the material properties of the finite elements have a particular symmetry;
- (4) calculating a material property matrix  $[k]$  based on the relationship  $\{f\}=[k]\{x\}$  and the specified symmetry, wherein the material property matrix  $[k]$  comprises a plurality of values each corresponding to one or more material property coefficients;
- (5) comparing each of the plurality of values in the material property matrix  $[k]$  to known material properties and, responsive to a match, selecting a corresponding manufacturing process parameter for a volume increment of the object, wherein the selected manufacturing process parameter is usable for controlling composite

manufacturing equipment if the matched known material property is a material property for a composite material;

(6) controlling the composite manufacturing equipment in accordance with the selected manufacturing process parameters to thereby manufacture the object; and

(7) introducing an impurity into the object while the object is manufactured, wherein an amount of the introduced impurity is variable for the respective volume increments of the object.

Claim 42 (Currently Amended): The method according to claim 41, wherein the object being manufactured is a prosthetic implant for replacing a body part and the field force {f} and potential displacement {x} are specified based on the in vivo forces applied to the body part to be replaced and the in vivo displacements generated in the body part to be replaced when the forces are applied thereto.

Claim 43 (Previously Presented): The method according to claim 1, wherein the impurity is selected from the group consisting of: biologic materials, bone, crushed bone, co-factors, biological cells, bio-active material, medications, antibiotics, and radioactive materials.

Claim 44 (Previously Presented): The method according to claim 25, wherein the impurity is selected from the group consisting of: biologic materials, bone, crushed bone, co-factors, biological cells, bio-active material, medications, antibiotics, and radioactive materials.

Claim 45 (Previously Presented): The method according to claim 41, wherein the impurity is selected from the group consisting of: biologic materials, bone, crushed bone, co-factors, biological cells, bio-active material, medications, antibiotics, and radioactive materials.

Claim 46 (Previously Presented): A method for manufacturing an object having a potential  $\{x\}$  that is generated in response to a field  $\{f\}$  applied thereto, the method comprising:

generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements and specifying values for the field  $\{f\}$  and potential  $\{x\}$  relative to the finite elements;

calculating a material property matrix  $[k]$  based on the relationship  $\{f\}=[k]\{x\}$ ;

extracting material property coefficients from the material property matrix  $[k]$  for each finite element in the computerized mathematical model;

comparing the extracted material property coefficients to material property coefficients for known materials to match the extracted material property coefficients to the material property coefficients for known materials;

determining, based on the matched material property coefficients, manufacturing parameters for controlling manufacturing equipment for volume increments of the object corresponding to the finite elements of the geometrical model of the object;

controlling the manufacturing equipment in accordance with the determined manufacturing parameters to thereby manufacture the object; and

introducing an impurity into the object while the object is manufactured,  
wherein an amount of the introduced impurity is controllably variable by the  
manufacturing equipment from any one volume increment to another.

Claim 47 (Previously Presented): The method according to claim 46, wherein  
the impurity comprises biologic material.

Claim 48 (Previously Presented): The method according to claim 46, wherein  
the impurity comprises bone.

Claim 49 (Previously Presented): The method according to claim 46, wherein  
the impurity comprises crushed bone.

Claim 50 (Previously Presented): The method according to claim 46, wherein  
the impurity comprises co-factors.

Claim 51 (Previously Presented): The method according to claim 46, wherein  
the impurity comprises biological cells.

Claim 52 (Previously Presented): The method according to claim 46, wherein  
the impurity comprises bio-active materials.

Claim 53 (Previously Presented): The method according to claim 46, wherein the impurity comprises medications.

Claim 54 (Previously Presented): The method according to claim 46, wherein the impurity comprises antibiotics.

Claim 55 (Previously Presented): The method according to claim 46, wherein the impurity comprises radioactive materials.